Spot Safety Project Evaluation

Project Log # 200404221

Spot Safety Project # 04-95-270

**Spot Safety Project Evaluation, of the Flashing Traffic Signal Installation,
At the Intersection of NC 231 and NC 222-SR 2105-Buck Road near Emit, Johnston County**

Documents Prepared By:

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_____ 07/15/2004
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Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 04-95-270 – The Intersection of NC 231 and NC 222-SR 2105-Buck Road near Emit, Johnston County

Introduction

In an attempt to assess the safety of our roads, the Safety Evaluation Section of the Traffic Safety Systems Management Unit has evaluated the above project. The methodologies used in this evaluation offer various philosophies and ideas, in an effort to provide objective countermeasure crash reduction results. A naive before and after analysis and a linear regression before and after analysis of the treatment versus comparison data have been completed to measure the effectiveness of the spot safety improvement. This information is provided to you so the benefit or lack of benefit for this type of project can be recognized and utilized for future projects.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of a flashing traffic signal. D.R. Dupree, Division Engineer, originally requested the flashing traffic signal. NC 231 is a two-lane facility with no left turn lanes at the intersection with NC 222-SR 2105-Buck Road. NC 222 and SR 2105-Buck Road are also two-lane facilities with no left turn lanes. NC 231, NC 222, and SR 2105-Buck Road have a speed limit of 55 mph. Angle accidents and left turn accidents occurred due to the motorists' limited sight distance at the intersection. The rural location also caused motorists to have difficulty recognizing the intersection. The initial crash analysis for this location was completed from August 1, 1989 through July 31, 1995 with a total of 7 reported crashes. There were 4 Angle crashes, 2 Left-Turn crashes, and 1 Random crash. The final completion date for the traffic signal installation at the subject intersection was on February 3, 1997.

Naive Before and After Analysis

After reviewing the spot safety project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period was from December 1, 1996 through March 31, 1997. The before period consisted of reported crashes from July 1, 1990 through November 30, 1996 (6 Years, 5 Months) and the after period consisted of reported crashes from April 1, 1997 through August 31, 2003 (6 Years, 5 Months). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed.

The analysis also consisted of two different sets of data, the treatment and the comparison data. The treatment data consisted of all crashes within 150 feet of the subject intersection. The comparison data consisted of all crashes within 150 feet of other 4 Leg intersections within the immediate analysis area. These other intersections have all been combined for the comparison data analysis and are as follows: NC 231 at SR 1720-Applewhite Road, NC 231 at NC 96, NC 222 at SR 1733-Antioch Church Road, NC 222 at SR 2110-Flower Hill and Glendale Road, and NC 222 at SR 2148-Bailey Road. The following data table depicts the Naive Before and After Analysis for the above information. Please note that Frontal Impact Crashes were the target crashes for the applied countermeasure. These crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; and Angle.

Treatment Information

	Before	**After**	**Percent Reduction (-)/ Percent Increase (+)**	**Statistically* Significant?**
Total Crashes	8	14	75.0	No
Total Severity Index	32.2	5.23	-83.8	Yes
Frontal Impact Crashes	8	12	50.0	No
Frontal Severity Index	32.2	5.93	- 81.6	Yes
Volume	1800	2600	44.4	Yes

Comparison Information

	Before	**After**	**Percent Reduction (-)/ Percent Increase (+)**	**Statistically* Significant?**
Total Crashes	40	39	- 2.5	No
Total Severity Index	5.07	7.5	48.0	No
Frontal Impact Crashes	26	29	11.5	No
Frontal Severity Index	5.55	6.1	9.9	No
Volume	2700	3300	22.2	Yes

* Statistical significance tested at the 80% confidence interval using the *T Test* methodology.

The naive before and after analysis at the treatment location resulted in a 75.0 percent increase in Total Crashes, a 50.0 percent increase in Frontal Impact Crashes, and a 44.4 percent increase in Average Daily Traffic (ADT). The comparison locations resulted in a 2.5 percent decrease in Total Crashes, an 11.5 percent increase in Frontal Impact Crashes, and a 22.2 percent increase in ADT. The before period ADT year was 1993 and the after period ADT year was 2000.

Linear Regression Before and After Analysis (Treatment versus Comparison Data)

Crash data was completed and analyzed from January 1, 1990 through August 31, 2003 for both the treatment and comparison data areas. This yearly crash data was then reduced from yearly data to crashes per month. The data was then placed into a graphical format for treatment and comparison data areas separated into before and after time periods for both Total Crashes and Frontal Impact Crashes. The before period consisted of crash data from January 1, 1990 through January 31, 1996 (7 Years, 1 Month) and the after period consisted of crash data from February 1, 1997 through August 31, 2003 (6 Years, 7 Months).

The linear regression of both the treatment and comparison data area was plotted for the before period for both the Total Crash and Frontal Impact Crash categories. The Total Crash category demonstrated similar slope comparisons within the linear regression for both the treatment and comparison data. Since the slopes were similar, it is reasonable to assume the treatment and comparison data sets are adequate for predicting crashes within the after period based on the likeness of data sets in the before period. The linear regression of both the treatment and comparison data area was also plotted for the after period for the Total Crash category. The slopes of this linear regression analyses were also used to determine predicted crashes in the after period. The Frontal Impact Crash category did not demonstrate similar slope comparisons with the linear regression for both the treatment and comparison data. Because the treatment and comparison data for Frontal Impact Crashes did not show likeness of data sets in the before period, the comparison data was not adequate for predicting crashes in the after period.

The *treatment predicted* crashes were found by projecting the linear regression equation in the before period of the treatment data to the beginning month of the *treatment actual* after period. The *treatment actual* after period within this analysis is from April 1, 1997 through August 31, 2003 (6 Years, 5 Months). The first prediction data comparison was to compare the linear regression equation crash results of the *treatment predicted* after period data versus the *treatment actual* after period data. The difference between these two linear equations resulted in the number of crashes for the first prediction method. The second prediction data comparison was to compare the linear regression equation crash results of the *comparison predicted* after period data versus the *treatment actual* after period data. The difference between these two linear equations resulted in the number of crashes for the second prediction method.

	Predicted	Actual	Percent Reduction (-)/ Percent Increase (+)	Statistically* Significant?
Treatment Predicted versus Treatment Actual				
Total Crashes	9	14	55.6	No
Comparison Predicted versus Treatment Actual				
Total Crashes	9	14	55.6	No

* Statistical significance tested at the 80% confidence interval using the *T Test* methodology.

The linear regression before and after analysis of the treatment versus comparison data resulted in the following crash reduction factors for the two comparisons analyzed. The *Treatment Predicted versus Treatment Actual* resulted in a 55.6 percent increase in Total Crashes at the treatment location. This comparison methodology is another type of naive before and after analysis using the assumption that the crashes in the before period would continue on the same linear regression as the crashes at the treatment location in the before period, if nothing had been done. The *Comparison Predicted versus Treatment Actual* resulted in a 55.6 percent increase in Total Crashes at the treatment location. This comparison methodology analyzes the *Treatment Actual* crashes compared to the *Comparison Predicted* crashes using the linear regression from the comparison area after period projected onto the treatment area. The method reflects crash trends in the comparison area to the treatment area.

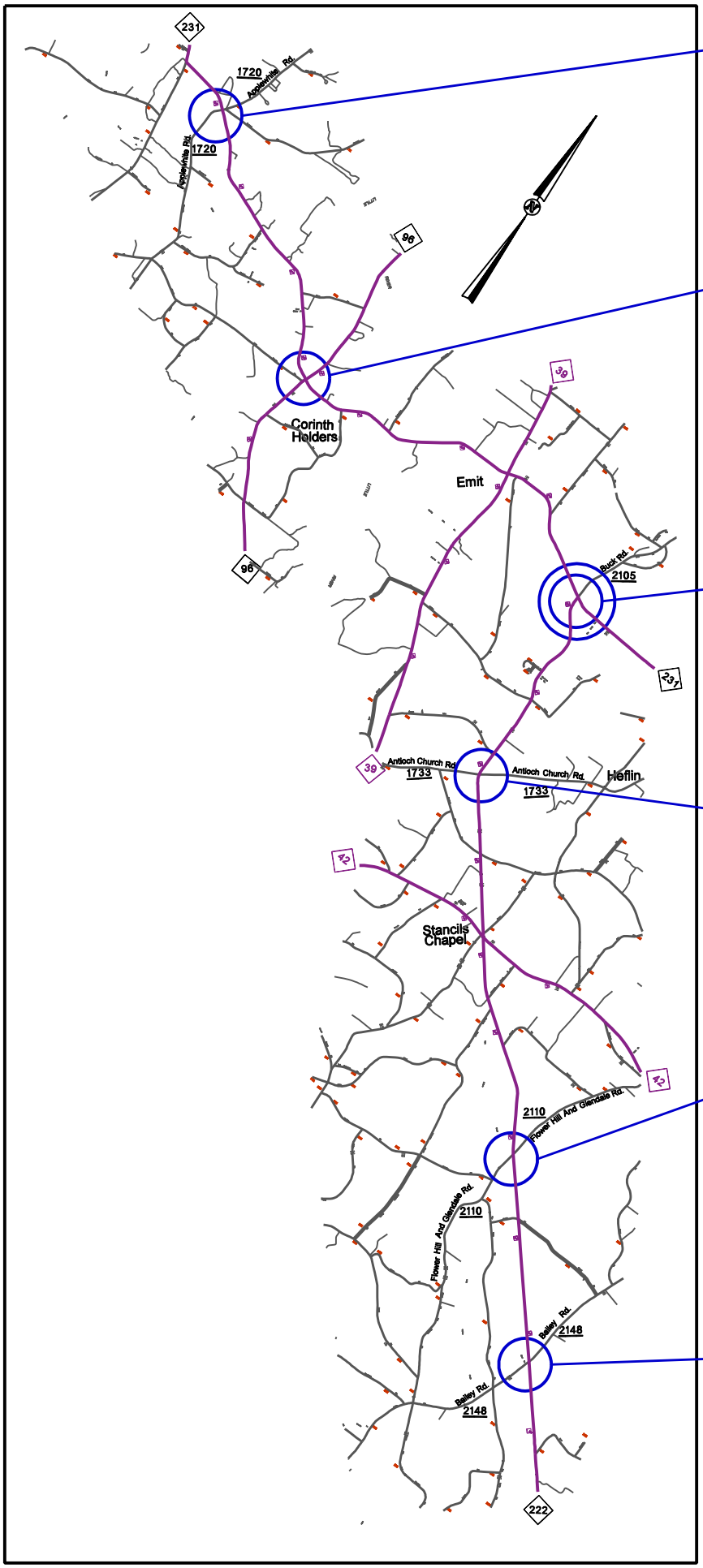
Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 75.0 percent increase in Total Crashes and a 50.0 percent increase in Frontal Impact Crashes. The treatment area linear regression analysis involving the comparison of treatment predicted after data versus treatment actual after data resulted in a 55.6 percent increase in Total Crashes. The comparison area linear regression analysis involving the comparison of comparison predicted after data versus treatment actual after data resulted in a 55.6 percent increase in Total Crashes. The Severity Index for Total Crashes and Frontal Impact Crashes at the treatment intersection decreased by 83.8 percent and 81.6 percent, respectively. The summary results above demonstrate that in all analysis methods the treatment location appears to have had a substantial crash increase from the before to the after period. Although there was an increase in the number of crashes at the treatment location, the crash severity decreased dramatically.

Please see the attached *Treatment Site Location Photos*. Photos are provided for each leg of the treatment intersection. Also, a photo is attached which shows the limited sight distance on the west leg of the intersection.

The countermeasure crash reduction for Total Crashes at the subject intersection can be in the range of a 55.6 percent increase to a 75.0 percent increase in crashes. The countermeasure crash reduction for Frontal Impact Crashes at the subject intersection is 50.0 percent, using only naive before and after analysis. As the Safety Evaluation Section completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors.

Location Map, Near Emit, Johnston County
Evaluation of Spot Safety Project Number 04–95–270



Comparison Site: NC 231 at SR1720–Applewhite Road

Comparison Site: NC 231 at NC 96

Treatment Site: NC 231 at NC222–SR2105–Buck Road

Comparison Site: NC 222 at SR1733–Antioch Church Road

Comparison Site: NC 222 at SR2110–Flower Hill and Glendale Road

Comparison Site: NC 222 at SR2148–Bailey Road

Treatment Site Location Photos (Taken on April 6, 2004)

Looking East at the Intersection of NC 231 and NC 222-SR 2105-Buck Road

Looking South at the Intersection of NC 231 and NC 222-SR 2105-Buck Road

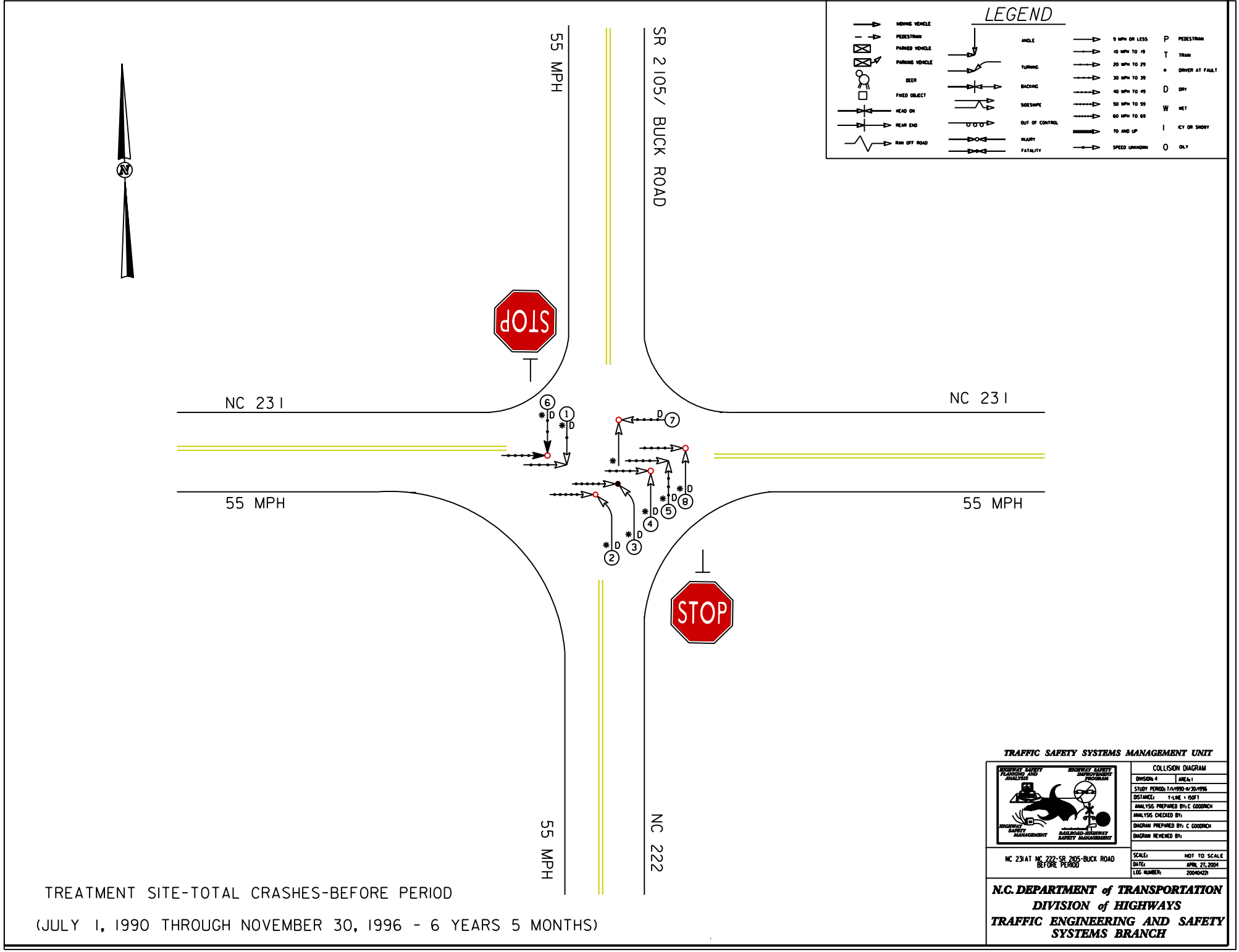
Treatment Site Location Photos (Taken on April 6, 2004)

Looking North at the Intersection of NC 231 and NC 222-SR 2105-Buck Road

Looking West at the Intersection of NC 231 and NC 222-SR 2105-Buck Road

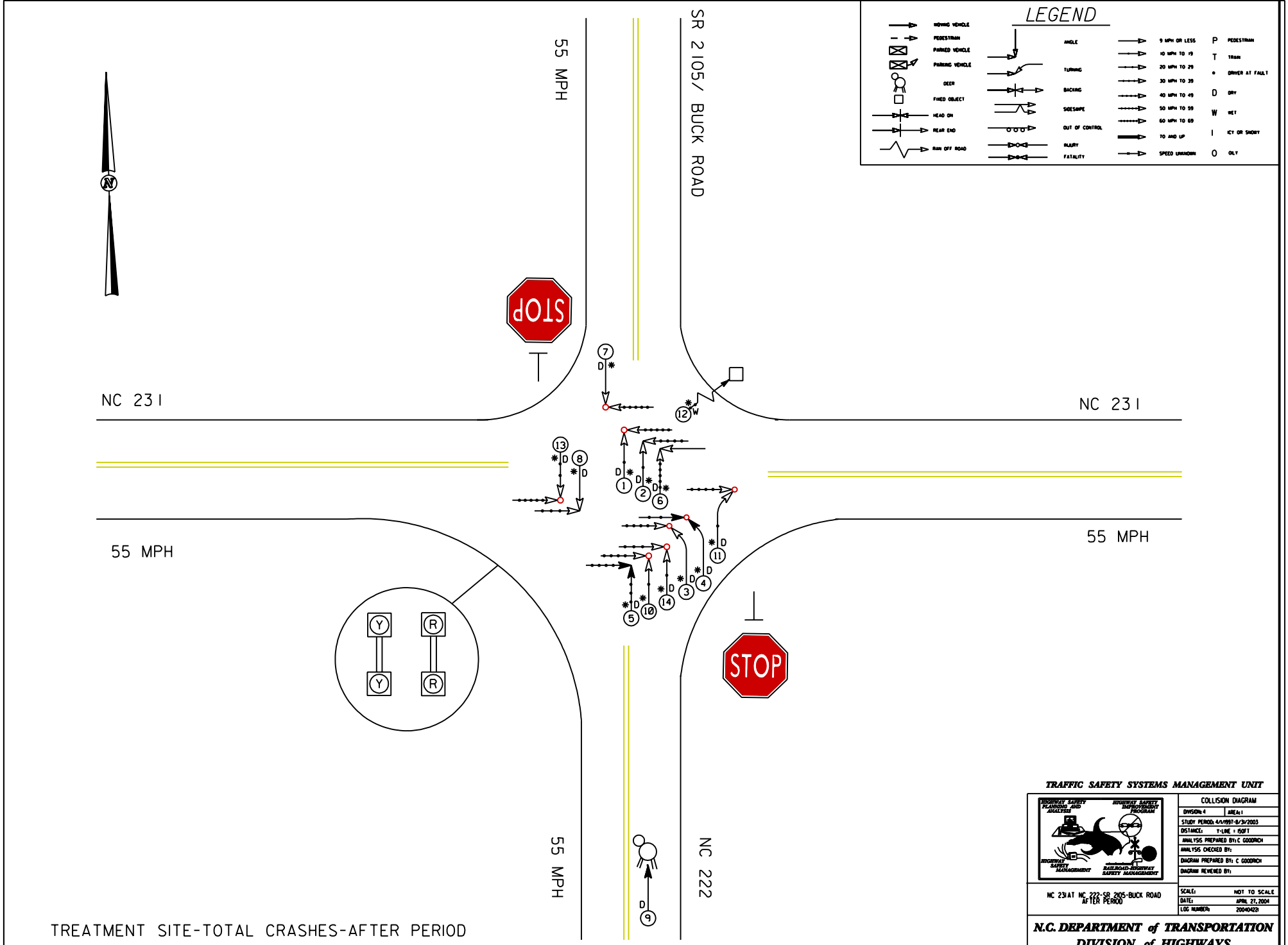
Treatment Site Location Photos (Taken on April 6, 2004)

Notice the limited sight distance on the west leg (NC 231) of the intersection.



TREATMENT SITE-TOTAL CRASHES-BEFORE PERIOD

(JULY 1, 1990 THROUGH NOVEMBER 30, 1996 - 6 YEARS 5 MONTHS)


LEGEND
55 MPH
SR 2105/ BUCK ROAD
NC 231
NC 231
55 MPH
55 MPH
55 MPH
NC 222
STOP
STOP
TREATMENT SITE-TOTAL CRASHES-AFTER PERIOD
(APRIL 1, 1997 THROUGH AUGUST 31, 2003 - 6 YEARS 5 MONTHS)
TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT
COLLISION DIAGRAM
NC 231 AT NC 222-SR 2105-BUCK ROAD
AFTER PERIOD
N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH